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ABSTRACT

Networked multimedia is described as a tool for collaborative learning, focusing on learning through discussion. It is proposed that multimedia may be used to structure and enhance communication, thereby promoting learning. The background and application of collaborative learning is outlined. Several dimensions of media which influence the evolution of its use are examined. Two examples of multimedia discussion tools are used as illustration: The Multimedia Forum Kiosk (MFK) and SpeakEasy, a discussion tool for World Wide Web (WWW). MFK is an interface for discussion that makes use of multimedia for socially relevant representations. MFK has two intended effects: to allow the user to internalize and learn from the community knowledge base, and to augment the knowledge base by synthesizing new ideas. SpeakEasy, currently an experimental discussion tool for WWW, builds upon the ideas of MFK. Because it is accessible via network, it is a different-times, different-places type of communication medium. As participants make assertions, questions, and responses to one another about various issues, a structured, graphical representation emerges making conceptualization of the discussion possible. Five figures illustrate the applications. (Contains 32 references.) (MAS)

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Networked Multimedia for Communication and Collaboration

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In this paper, we describe the use of networked multimedia as a tool for collaborative learning. Specifically, we focus on using multimedia to foster learning through discussion. While instructional multimedia is currently enjoying a heyday, few use multimedia as a collaborative communication medium. We propose that multimedia may be used to structure and enhance communication, and thereby promote learning. Two examples of discussion tools are given to illustrate our position: The Multimedia Forum Kiosk and SpeakEasy, a discussion tool for the World Wide Web.

Collaborative Learning

In recent years, collaborative learning has come to the forefront as an educational technique worthy of study. Two movements have contributed to the resurgence of group learning. First, as the constructivist perspective has taken hold, educators are beginning to rebel against information transmission as a style of teaching. In traditional teaching styles, the primary goal of instruction is to convey information. Lectures and books present information in a form as precise and condensed as possible. Homework and tests focus on recall of the facts contained in the textbooks or lectures. While many have tried to break out

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of this paradigm, it is still the dominant one, reinforced by standardized textbooks and large class sizes which discourage more interactive styles. Although it is possible to emphasize processes and problem-solving in these traditional formats (for example, through the use of case studies), students do not have much opportunity to construct their own knowledge in passive activities such as reading and listening to lectures. Discussion is an alternative to lectures and book-reading which enjoys a long history in the classroom. It permits interactivity and acknowledges the student's perspective, and thus seems a natural choice for constructivist learning.

Another movement contributing to the recent interest in collaborative learning is the *social cognition* perspective. The Russian psychologist Vygotsky studied development in children as a primarily social process (1978). He noted that children could do more with assistance (from parents, teachers, or peers) than they could in isolation. He termed the gap between solo and assisted competence the *zone of proximal development*, and hypothesized that development was the result of internalizing the help of others (Newman, Griffith, and Cole, 1989). Recently, many psychologists have rediscovered the Vygotskian perspective on development, and have begun examining learning and cognition as social processes, using techniques from anthropology and sociology. (Vera & Simon, 1993). Lave and Wenger (1991) and others have studied learning as an enculturation process; they identify *legitimate peripheral participation* as the process through which novices are enculturated into expert practice.

While controversy surrounds the social cognition perspective (see, for example, the special issue of *Cognitive Science* devoted to this debate, Vera & Simon, 1993) many researchers have had great success using collaboration in the classroom for learning. For example, both the jigsaw method and reciprocal teaching method have been used with great success (Aronson, 1978; Palinscar & Brown, 1984). In both of these teaching methods, students

take on various roles in the knowledge building process, then work with others towards group understanding. Both of these methods fit in the paradigm of *cognitive apprenticeship*, where students are exposed to expert performance, scaffolded through the procedures themselves, and gradually work with less and less help (Collins, Brown, & Duguid, 1989; Collins, Brown, & Holum, 1991) .

Collaboration is not a panacea. It can cause more problems than it solves (Burbules and Linn, in press; Madhok, 1993) Students may be belittled or misinformed. They may fall prey to groupthink that leads to incorrect conclusions. They may do the work unequally. They may be of such differing abilities that they fail to communicate. They may fail to assure that every group member learns. These pitfalls must be avoided by carefully structuring the collaborative activities and the structure of the groups so that each student has an opportunity to learn.

Collaborative learning activities can yield several real advantages. Students may be directed by social forces, such as desire to earn the respect of those they admire. They may be more likely to stay on task if others are doing the same. They may feel more commitment to peers than to teachers. Presentation of one's ideas to others is an excuse to formulate a clear opinion, and to check that opinion against other students. If a group has a goal of reaching consensus, discussion becomes a sensemaking activity in which students must grapple with multiple views of the material and decide among them. Learning can become a process of transformation, rather than transmission (Pea, 1994); rather than ingesting bits of knowledge transmitted by the teacher, the students must as a group transform their incomplete understanding into a more complete one.

If we take seriously the idea of collaborative learning, we must examine how to foster these collaborations. In order to do this, we examine some features of communication media that allow collaboration.

Media for Communication

Media are the way we communicate with one another. Whether we examine mass media such as television, book publishing, or radio; or personal media such as letters, telephone calls, or face-to-face meetings, each involves an act of communication. (For the purposes of this paper we will use the term medium to refer to a particular model of communication, e.g. a telephone call, and the term modality to refer to the sensory input the medium caters to, e.g. aural speech). Media differ in how, when, and where they are used. Media differ in their character, which is partly a result of the nature or physical constraints of the medium, and partly a result of the culture of the medium or the expectations its users bring to it. Indeed, usage of the medium evolves as a result of both the constraints and the culture the medium is brought to. (Perin, 1991) Below we examine several dimensions of media that can influence this evolution. We shall focus primarily on *computer-based multimedia*, (multimedia for short), or electronic media that combine multiple modalities.

One basic dimension of media is who is communicating with whom. How many people are involved and what is their relationship with each other? This communication may be one-to-one, one-to-many, or many-to-many. A crucial distinction is whether the communication is unidirectional or bi-directional. In most multimedia, communication is unidirectional. The author of the media has a message, and the audience reviewing the media at some later date is receiving the message. In mass media, the author's message is received by many individuals. Rarely does the audience get to participate in the media and communicate with the original author. Indeed, the most prevalent multimedia technology, CD-ROM's, even prevent modifying the media once it is received, much less using it to

communicate with an author. Unidirectional media preclude the type of collaborative learning we are trying to achieve.

Another dimension is the timescale of the medium. Other electronic media for communication such as the fax machine, electronic-mail, a phone, have inherent characteristics that constrain their use, and define expectations in users in how they should be used. A fax is more immediate than a letter sent by airmail, but not as immediate as a telephone conversation. The timescale of the medium however does nit always determine how it is used. Expected responses times for different communication media is formed by the community that uses it, especially in electronic communities (Riel & Levin, 1990).

A third dimension of media is collocation in time and space. A frequently reproduced table divides media into synchronous or asynchronous (participants are communicating simultaneously or may act at different times), and into local or distant (participants are in the same place or are in different places). Until recently computer multimedia was largely local, due to the high requirements for transporting multimodal information.

As computers have evolved from an expensive, mostly text-based machine to an affordable vehicle for media, this allows individuals to produce for many. However, computer experts (not instructors or even authors and publishers) controlled this medium until recently.

Increased technology breaks many old barriers. Computers have evolved from an expensive, mostly text-based machine to an affordable vehicle for many types of media. Current electronic documents are multimodal, that is they can contain not only roman text, but other alphabets, images, even sound and movies. They are infinitely replicable, and may be sent in moments anywhere in the world. Perhaps most importantly, they are cheap

to produce and thus may be used for one-to-one or many-to-many communication, not just the one-to-many broadcast so familiar now. It is this change that allows us to use the computer medium for communication and collaborative learning, not just publishing. There are a few examples of using computer multimedia for communication tools in the service of learning, such as CSILE (Scardamalia & Bereiter, 1992), the CoVis Notebook (Edelson & O'Neill, 1994), and BoardwalkHC (Bellamy, Woolsey, & Kerns, 1995) where students might comment on each others' published works or students and teachers might respond to each other through annotations.

Electronic Collaborative Learning Environments

Current instructional technology, namely networked multimedia, permits nearly any configuration of the computerized medium. Therefore, the crucial question is, *how can media be designed appropriately for learning?* Already, computer users are bombarded with different ways to talk via computer: email, newsgroups, bulletin boards, real-time messaging, and so on. Slowly, instructional technology has come to realize there is no single answer; different media configurations have different strengths, weaknesses, and characters. However, the question of how to capitalize on technology remains. And this is an important question, since the structure of the media can greatly affect the type of communication that occurs in it.

Socially Relevant Representations

Our position is that an electronic collaborative learning environment can best use networked multimedia for learning if the information is presented in both a well structured and socially relevant manner. A computer interface can be designed to capitalize on theories of collaborative learning and different media characteristics for communication. Moreover, the activity that makes learning relevant is discussion. Our view is that discussion helps make information personal, and cognition is supported through presentation of social

context information. Social context information includes information about individual people, their personality, their views and other information that might not be germane to the content area under discussion but that are important for making sense of and learning from the discussion.

Here, we provide two examples of multimedia discussion tools that make use of socially relevant representations of discourse.

The Multimedia Forum Kiosk

The Multimedia Forum Kiosk (Hoadley & Hsi, 1992, 1993; Hoadley, Hsi, & Schwarz, 1992; Hsi & Hoadley, 1994; Hsi, Berman, & Hoadley, 1995) is a an interface for discussion that makes use of multimedia for socially relevant representations. The Multimedia Forum Kiosk has two intended effects on the user: to allow the user to internalize and learn from the community knowledge base, and to augment the knowledge base (construct knowledge) by synthesizing new ideas. The metaphor for the system is a productive working discussion. Users learn through contributing to a community knowledge base and negotiating meaning through an asynchronous electronic discussion. This system is not networked, so it falls in the category of same-place, different-time media.

In the MFK system, an author introduces an idea or question, and participants of the discussion each contribute their viewpoint. The topics are introduced with stimulus materials that might be images, text, video, or audio. Each comment from a participant is represented by a face icon, so the identity of the contributor is immediately obvious; on the other hand, participants may remain anonymous and choose a cartoon icon if they wish not to be identified. Two screens are associated with each topic: an *Opinion Area*, in which users each state their overall opinions on the topic (only one comment per person is

allowed, although it may be changed at any time), and a *Discussion Area*, in which users may respond to each others' statements. A graphical representation and categorization scheme display the unfolding discussion as a series of trees (called argument trees). Each comment is a node, and links from responses to prior comments are drawn graphically. Each link is labeled with a category that describes its relationship to the prior comment.

Multimedia technology aided in creating socially relevant representations of discourse in three ways. First, face icons of all participants of the discussion made identities salient. This allowed discussion to take on a more personal tone since participants were reminded that real people were behind each comment, and allowed participants to more easily keep track of each others' views using humans' well-tuned ability to recognize and remember faces. A second feature of multimedia was the use of images, computerized documents, and digital movies as discussion stimulus materials. Video especially was used to bring concrete examples into the discussion, to link examples of activities students had been experiencing in the classroom, or to import personal stories and add a more human feel to the topic. These images and videos were often more poignant and more effective at starting discussion than vague, depersonalized references in text. Third, computer graphics technology allowed development of the argument tree representation for ongoing, back-and-forth discussion. Without this representation, it would have been difficult to allow an asynchronous many-to-many discussion. The representation allows users to glean the relationships between statements without requiring a linear structure.

We view individuals using MFK as an intellectual tool for making explicit what is already implicitly represented in arenas such as face-to-face discussion. People remember knowledge by building on mental representations that are familiar, and socially relevant representations in interfaces capitalize on our well-developed social skills. Individuals learn when they communicate in the system by interpreting the stimuli and the conversation so

far, formulating their own opinions, and then reflecting on how their views fit in to the entire discussion.

Our research to date indicates that people using the MFK system can use the system for effective learning discussions where they might not otherwise be able to hold discussions, that these discussions can form a useful part of a curriculum, and that the structure of the interface helps contribute to users' learning. More conclusive results are expected soon.

SpeakEasy: A Structured Arena for On-line Discussion

SpeakEasy, currently an experimental discussion tool for the World Wide Web (Hoadley, Berman, & Hsi, 1995), builds upon the ideas of the Multimedia Forum Kiosk. Because it is accessible via network, it is a different-times, different-places type of communication medium. As with the Kiosk, discussion in SpeakEasy is organized around different topics, each encompassing various sub-issues. As participants make assertions, questions, and responses to one another about these various issues, a structured, graphical representation emerges making conceptualization of the discussion possible.

Another ideal of the Kiosk built into the structure of SpeakEasy is the importance of the *participant community*. Socially relevant representations provide discussion participants with knowledge about the backgrounds, ideas, and leanings of other participants to help represent the discussion. SpeakEasy, like the MFK, incorporates participants' faces in the on-line representation, as well as providing an Opinion Area dedicated to giving participants the ability to voice their overall ideas on the topic at hand. By having access to these different representations, users can get a better feel for the participant community at large. We hypothesize that participants in a SpeakEasy discussion have an easier time keeping large discussions intact and coherent in their minds (compare with UNIX

readnews, which also allows open-ended discussion but does not provide much in the way of social context knowledge.)

Another important feature of the SpeakEasy interface is that it allows seamless integration with other World Wide Web-based multimedia information. Users may include links in their comments that refer to other multimedia or hypertext information on the Internet. We expect this feature to aid integration of the discussion tool into other multimedia based activities. We are currently integrating this tool with other World Wide Web materials for precollege science education as a part of the KIE (Knowledge Integration Environment) project, a project funded by the National Science Foundation and led by Marcia C. Linn of the University of California, Berkeley. By incorporating multimedia science evidence into structured discussion, we hope to bring the benefits of socially relevant representations to science reasoning.

Summary

In this paper, we proposed that collaborative learning is a successful teaching strategy and that media may be structured to help encourage productive collaboration. We discussed the features of networked multimedia and proposed *socially relevant representations* as a theoretical basis for constructing useful multimedia interfaces for collaboration. Finally, we examined two tools built upon the theory of socially relevant representations and identified how they can serve as useful models for collaborative interfaces.

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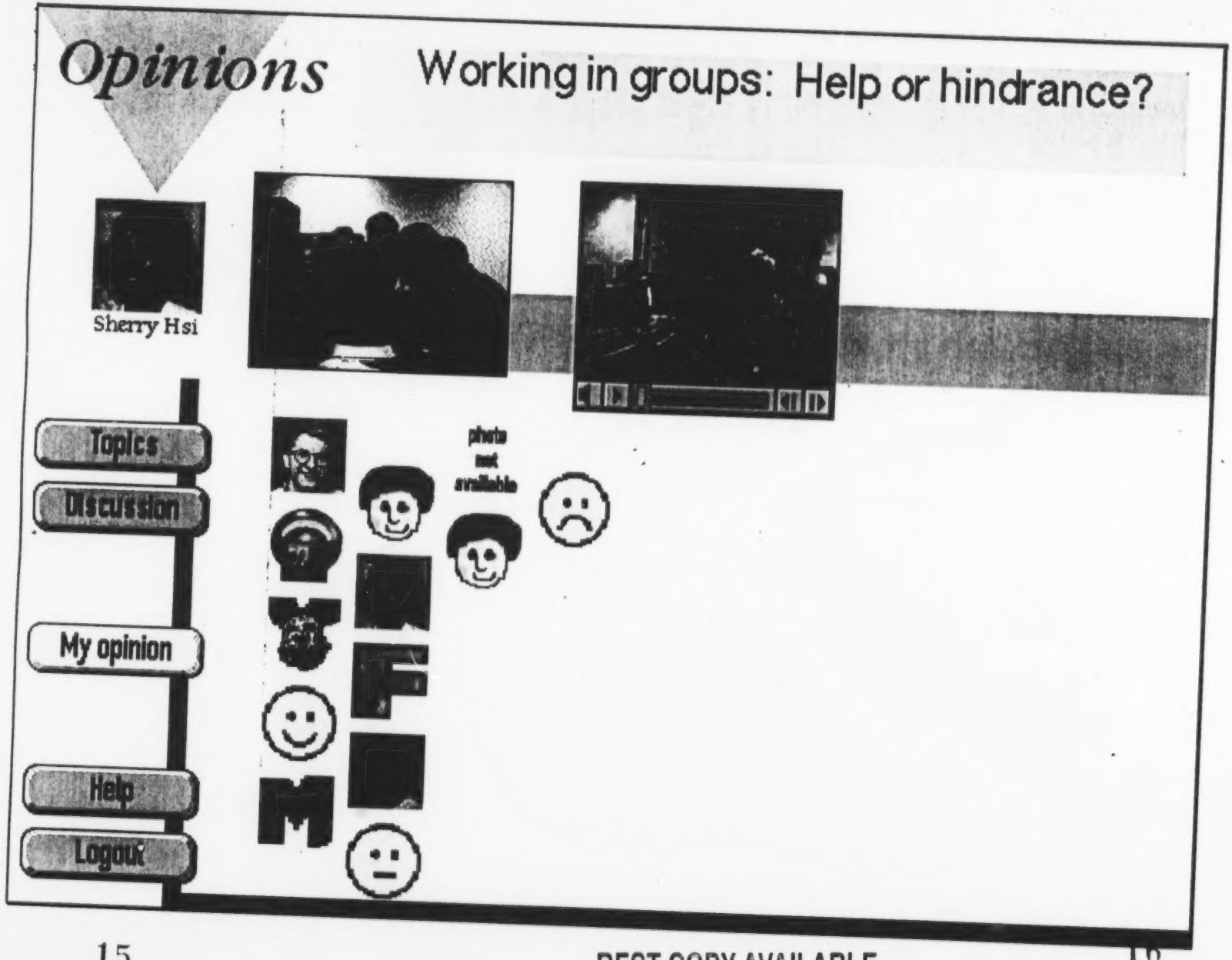

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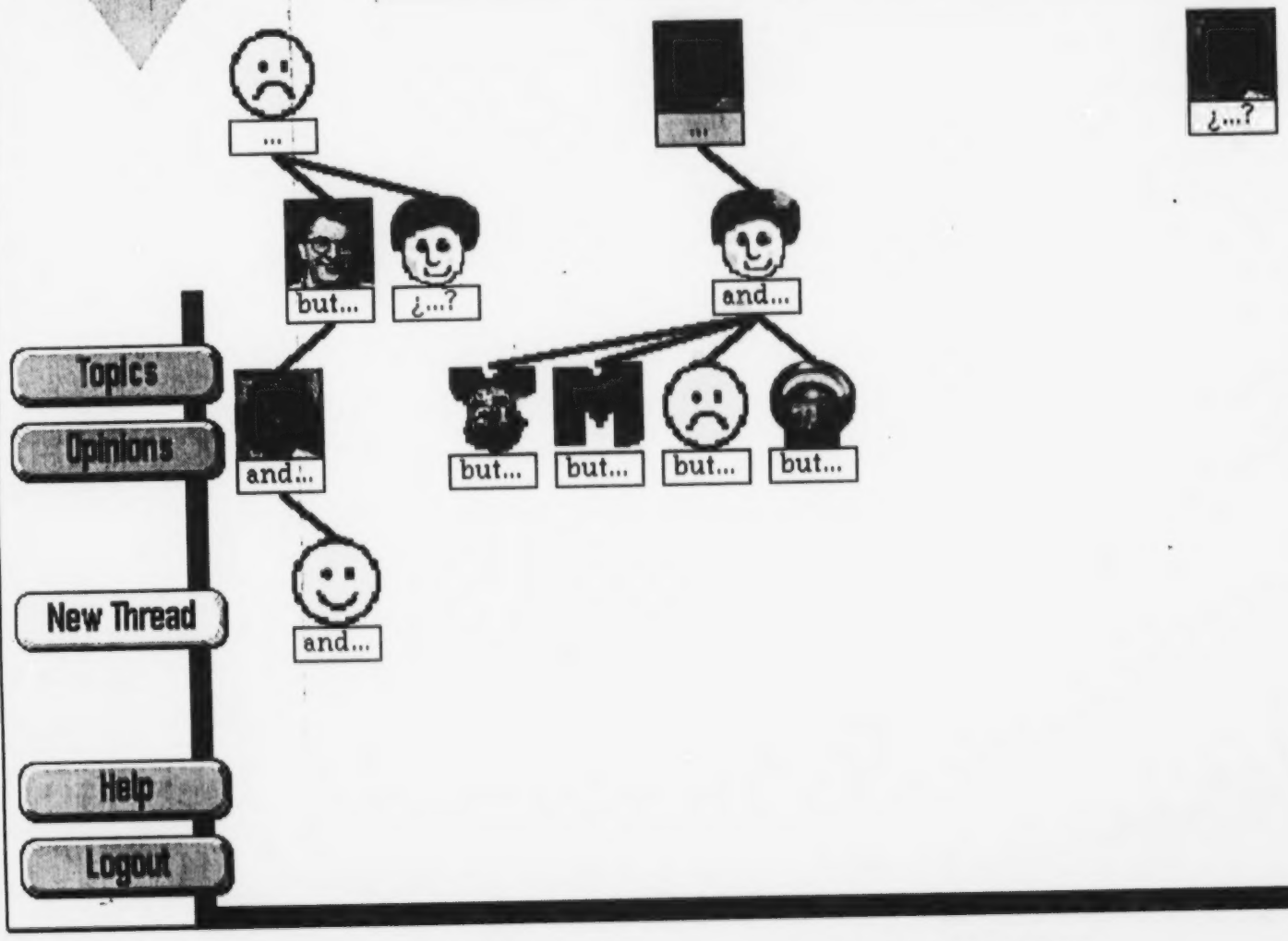
Discussion Working in groups: Help or hindrance?



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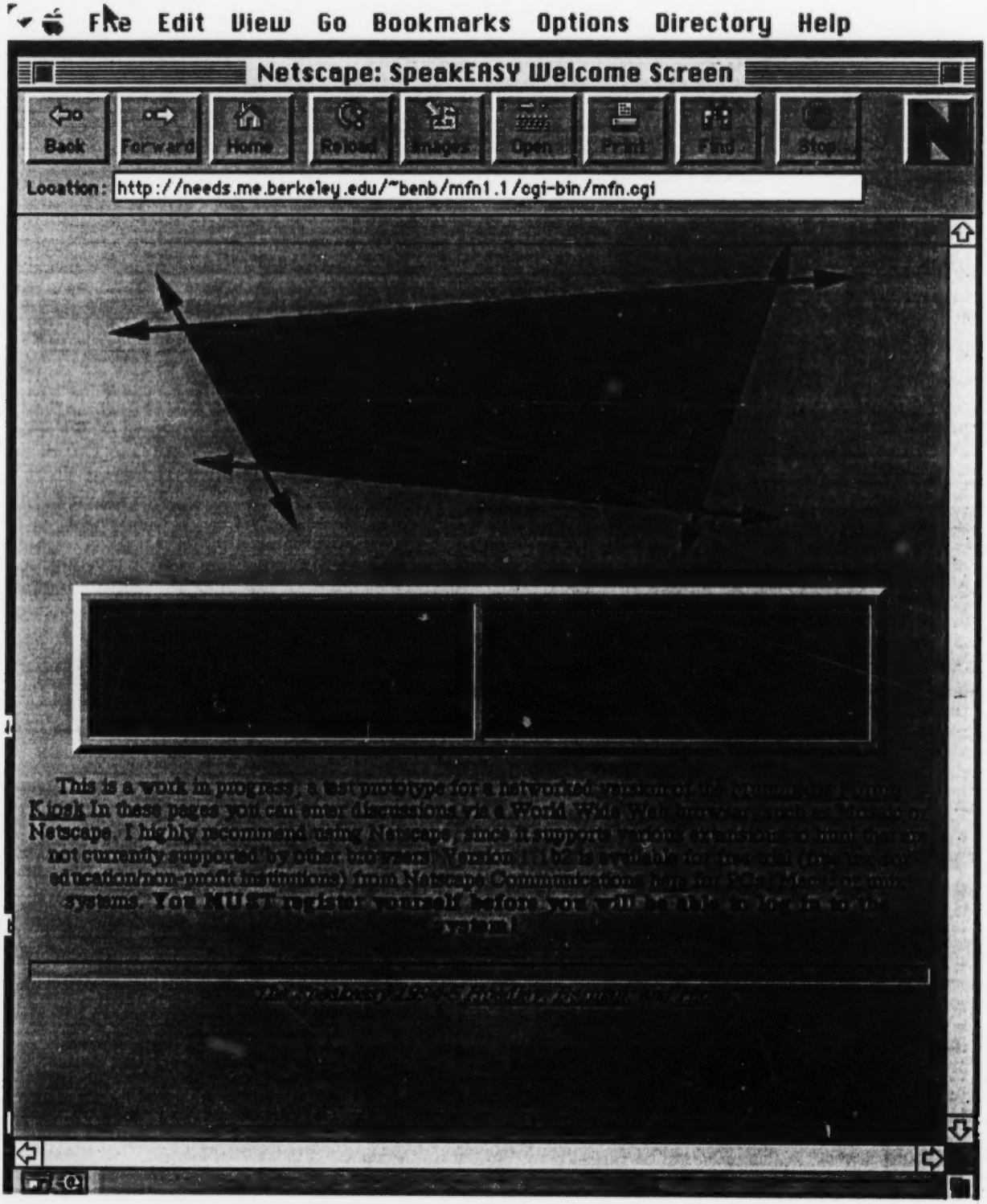

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Netscape: MFN: Milkshakes

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eileen (Eileen L. Lewis)
http://kie.berkeley.edu

12/13/94 -- 12:30pm

Comment Text

This is a question about heat energy from an interview I conducted with eighth graders. You and your friend are sharing a milk shake. Because you aren't very hungry, you and your friend divide it up as you see here.

What can you say about the heat energy present in each of your glasses of milk shake? Does one glass of milk shake have more heat energy than the other or are they the same? Why do you think that? What is heat energy, anyhow? Which will absorb more heat from the environment in a warm, room-temperature setting?

Opinions on this subject

Issues for discussion so far

- heat energy vs. temperature

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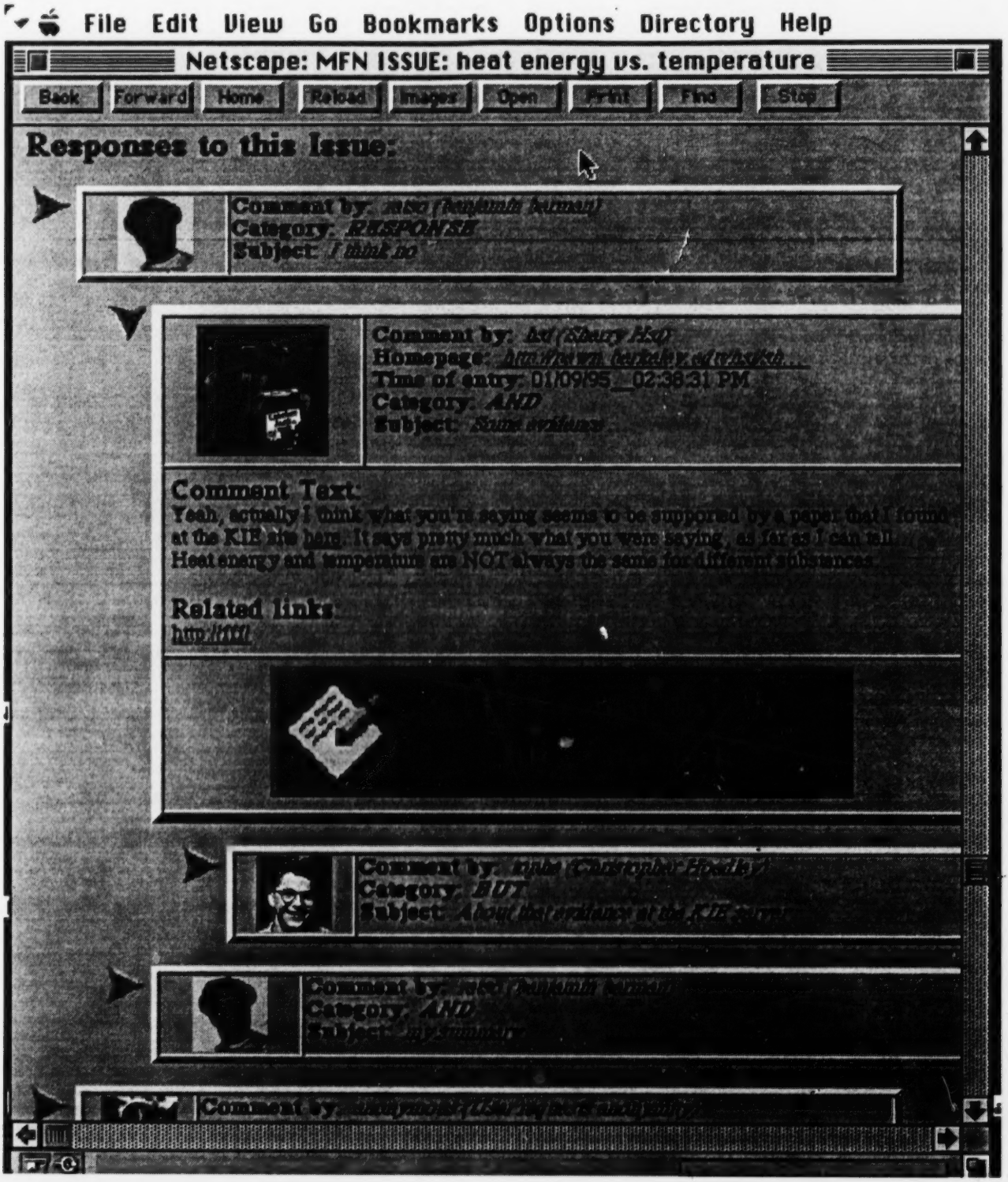
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Yeah, actually I think what you're saying seems to be supported by a paper that I found at the KIE site here. It says pretty much what you were saying, as far as I can tell. Heat energy and temperature are NOT always the same for different substances.
Related links:
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